

1           1. In an apparatus for continuously molding  
2 fastener elements integral with a base web from a flowable  
3 resin, the apparatus comprising  
4           a cylindrical mold roll rotatable about an axis of  
5 rotation and defining small fastener element-shaped mold  
6 cavities in a molding region of the surface thereof, and  
7           pressure-applying means to apply operating pressure  
8 to force the resin into said cavities at a pressure zone in  
9 the vicinity of the molding region, said pressure-applying  
10 means and mold roll defining a mold gap therebetween at the  
11 molding region for forming said base web, the apparatus  
12 characterized in that  
13           the apparatus includes means to maintain said mold  
14 gap at a desired thickness profile across the width of said  
15 wide web under said operating pressure.

1           2. The apparatus of claim 1 in which the molding  
2 region of the mold roll is longer than about 12 inches to  
3 produce a correspondingly wide web.

1           3. The apparatus of claim 1 in which the pressure  
2 applying means is capable of applying load to said mold roll  
3 in the range of about 1000 to 1600 pounds per lineal inch  
4 along said mold roll.

1           4. The apparatus of claim 1 in which said mold  
2 roll comprises an axially arranged stack of a large  
3 multiplicity of disks, at least many of which have mold  
4 cavities at their peripheral surfaces.

1           5. The apparatus of claim 1 in which said means to  
2 maintain the mold gap comprises a moving support member on  
3 the side of said mold roll generally opposite said pressure-

4 applying means, said support member disposed to engage the  
5 peripheral surface of the mold roll with sufficient force to  
6 resist radial deflection of said mold roll.

1           6. The apparatus of claim 5 in which said  
2 pressure-applying means comprises a pressure roll, said mold  
3 gap comprising a nip between said mold roll and pressure  
4 roll.

1           7. The apparatus of claim 5 in which said  
2 pressure-applying means comprises a nozzle assembly for  
3 introducing said resin to the pressure zone under pressure,  
4 said mold gap comprising a gap between said nozzle assembly  
5 and the mold roll.

1           8. The apparatus of claim 5 further comprising  
2 means to extract heat from the surface of the support member  
3 to cool the support member.

1           9. The apparatus of claim 3 further comprising a  
2 support member controller to vary the amount of engagement  
3 between the mold roll and the support member in response to  
4 operating conditions.

1           10. The apparatus of claim 9 further comprising a  
2 sensor to provide operating condition information to the  
3 support member controller.

1           11. The apparatus of claim 10 in which the sensor  
2 is constructed to detect the presence of molded resin on the  
3 peripheral surface of the mold roll, the controller being  
4 constructed to disengage the support member from the

1 peripheral surface of the mold roll when resin is not  
2 present.

1 12. The apparatus of claim 10 in which the sensor  
2 is constructed to respond to a condition of the apparatus  
3 that is related to the pressure in the pressure zone.

1 13. The apparatus of claim 1 in which the depth of  
2 the mold cavities from said surface is between about 0.004  
3 and 0.035 inches.

1 14. The apparatus of claim 13 in which the depth of  
2 the mold cavities from said surface is between about 0.005  
3 and 0.020 inches.

1 15. The apparatus of claim 13 in which the depth of  
2 the mold cavities from said surface is between about 0.006  
3 and 0.012 inches.

1 16. The apparatus of claim 13 in which the mold  
2 cavities define the shape of functional fastener elements.

1 17. The apparatus of claim 16 in which said  
2 functional fastener elements are hook elements constructed  
3 to engage loops or fibers.

1 18. The apparatus of claim 1 in which said mold  
2 cavities at least partially define the shape of loop or  
3 fiber-engaging hook elements, each element having a pedestal  
4 or stem portion and at least one head portion that projects  
5 to a side of said pedestal or stem portion.

1            19. The apparatus of claim 5 in which the support  
2 member has a peripheral surface that is resiliently  
3 deformable to conform, in the vicinity of its engagement  
4 with the mold roll, generally to the peripheral surface of  
5 the mold roll.

1            20. The apparatus of claim 19 in which the portion  
2 of the support member that directly contacts the surface of  
3 the mold roll is of a resilient substance.

1            21. The apparatus of claim 20 in which said portion  
2 is of elastomeric material.

1            22. The apparatus of claim 19 in which the support  
2 member comprises a generally cylindrical roll arranged to  
3 rotate about an axis.

1            23. The apparatus of claim 19 in which the support  
2 member comprises a belt supported to engage the mold roll.

1            24. The apparatus of claim 1 in which said means to  
2 maintain the mold gap comprises a means to elastically  
3 deform the shape of said pressure-applying means, to conform  
4 to radial deflection of the mold roll.

1            25. The apparatus of claim 24 in which said  
2 pressure-applying means comprises a pressure roll, said mold  
3 gap comprises a nip between said mold roll and pressure  
4 roll, and said means to elastically deform is constructed to  
5 bend the axis of said pressure roll to maintain the mold  
6 gap.

1           26. The apparatus of claim 24 in which said  
2 pressure-applying means comprises a nozzle assembly for  
3 introducing said resin to the pressure zone under pressure,  
4 said mold gap comprises a gap between said nozzle assembly  
5 and the mold roll, and said means to elastically deform is  
6 constructed to bend said nozzle assembly along the length of  
7 said mold gap to maintain the mold gap.

1           27. The apparatus of claim 1 in which said  
2 pressure-applying means comprises a pressure roll rotatable  
3 about an axis and positioned to form a nip with said mold  
4 roll to provide said mold gap, said means to maintain the  
5 mold gap including a controller to vary the angle between  
6 the axes of said pressure and mold rolls to introduce skew  
7 to compensate for mold roll deflection under said operating  
8 pressure.

1           28. An apparatus for continuously molding two  
2 streams of fastener product from flowable resin, each  
3 comprising a base web with integral fastener elements, the  
4 apparatus comprising  
5           a cylindrical mold roll rotatable about an axis and  
6 defining small fastener element-shaped mold cavities in the  
7 surface thereof in a molding region,  
8           first and second pressure-applying means to apply  
9 elevated operating pressure to force the resin into said  
10 cavities at corresponding first and second pressure zones,  
11 said first and second pressure-applying means and mold roll  
12 defining corresponding first and second mold gaps  
13 therebetween for forming said base webs in said molding  
14 region, and  
15           first and second product-removing means to remove  
16 the product from the mold roll,

1        said first and second pressure-applying means being  
2 arranged on generally opposite sides of said mold roll, such  
3 that bending loads applied to said mold roll by said  
4 elevated operating pressure are substantially balanced.

1        29. The apparatus of claim 28 wherein the molding  
2 region of the mold roll is of about 12 inches or more in  
3 length to produce correspondingly wide webs.

1        30. The apparatus of claim 28 in which said first  
2 and second pressure-applying means each comprises a pressure  
3 roll, said first and second mold gaps each comprising a nip  
4 between said mold roll and a corresponding said pressure  
5 roll.

1        31. The apparatus of claim 28 in which said first  
2 and second pressure-applying means each comprises a nozzle  
3 assembly for introducing said resin to the corresponding  
4 pressure zone under pressure, said first and second mold  
5 gaps each comprising a gap between a corresponding said  
6 nozzle assembly and the mold roll.

1        32. The apparatus of claim 1 wherein said pressure-  
2 applying means is constructed to apply first and second  
3 operating pressures at corresponding first and second said  
4 pressure zones at first and second mold gaps, respectively,  
5 with said mold roll.

1        33. The apparatus of claim 32 wherein said  
2 pressure-applying means comprises a nozzle assembly for  
3 introducing resin to said first pressure zone at said first  
4 operating pressure, said first mold gap comprising a gap  
5 between said nozzle assembly and the mold roll.

1           34. The apparatus of claim 33 wherein said  
2 pressure-applying means further comprises a pressure roll,  
3 said second mold gap comprising a nip between said mold roll  
4 and pressure roll.

1           35. An apparatus for continuously molding small  
2 fastener elements integral with a base web from a flowable  
3 resin, the apparatus comprising  
4           a cylindrical mold roll rotatable about an axis and  
5 defining fastener element-shaped mold cavities at a surface  
6 thereof in a molding region, and  
7           pressure-applying means to apply operating pressure  
8 to force the resin into said cavities at a pressure zone,  
9 said pressure-applying means and mold roll defining a mold  
10 gap therebetween for forming said base web,  
11           the apparatus including a roll arranged to engage  
12 said mold roll with substantial force, and which has a  
13 resiliently deformable surface to conform, in the vicinity  
14 of its engagement with the mold roll, generally to the  
15 peripheral surface of the mold roll in said molding region.

1           36. The apparatus of claim 35 in which said roll  
2 having a resiliently deformable surface comprises a pressure  
3 roll positioned to form a wide nip with said mold roll to  
4 provide said mold gap.

1           37. The apparatus of claim 36 in which said molding  
2 region of the mold roll is of about 12 inches or more in  
3 length to produce a correspondingly wide web.

1           38. The apparatus of claim 35 in which said roll  
2 having a resiliently deformable surface comprises a support  
3 roll disposed to engage the mold roll on the side generally

4 opposite said pressure-applying means to resist deflection  
5 of said mold roll.

1           39. The apparatus of claim 35 for producing a  
2 laminated fastener product comprising a molded web and a  
3 backing material, wherein said resilient roll and said mold  
4 roll define therebetween a laminating zone for laminating  
5 said molded web to said backing material.

1           40. An apparatus for continuously molding fastener  
2 elements integral with a base web from a flowable resin,  
3 comprising  
4           a cylindrical mold roll rotatable about an axis and  
5 defining fastener element-shaped mold cavities at a surface  
6 thereof,  
7           pressure-applying means to apply elevated operating  
8 pressure to force the resin into said cavities at a pressure  
9 zone, said pressure-applying means and mold roll defining a  
10 mold gap therebetween for forming said base web, and  
11           a belt arranged to engage a surface of said mold  
12 roll.

1           41. The apparatus of claim 40 in which said belt is  
2 arranged to engage the mold roll on the side generally  
3 opposite said pressure-applying means to resist radial  
4 deflection of said mold roll.

1           42. The apparatus of claim 40 in which said belt  
2 and said mold roll define a laminating zone therebetween for  
3 laminating said molded web to a backing material.



1           43. The apparatus of claim 40 in which said belt is  
2 constructed to extract heat from the surface of said mold  
3 roll.

1           44. In an apparatus for continuously molding  
2 fastener elements integral with a base web, the apparatus  
3 comprising

4           a cylindrical mold roll rotatable about an axis and  
5 defining fastener element-shaped mold cavities in the  
6 peripheral surface thereof in a molding region,

7           a nozzle assembly to introduce a flowable resin to  
8 said cavities, said nozzle assembly being constructed and  
9 arranged to apply operating pressure to force the resin into  
10 said cavities at a pressure zone, said nozzle assembly and  
11 mold roll defining a mold gap therebetween for forming said  
12 base web, the apparatus characterized in that

13           the apparatus includes means to maintain said mold  
14 gap at a desired thickness profile across the length of said  
15 molding region under said operating pressure.

1           45. The apparatus of claim 44 wherein the molding  
2 region of said mold roll is of about 12 inches or more in  
3 length to produce a correspondingly wide web.

1           46. The apparatus of claim 44 in which said means  
2 to maintain the mold gap comprises

3           a support member disposed to engage the mold roll on  
4 the side generally opposite said nozzle assembly with  
5 sufficient force to resist axial deflection of said mold  
6 roll, and

7           a controller constructed to vary the amount of  
8 engagement between said support member and said mold roll.

1           47. The apparatus of claim 46 in which said support  
2 member has a peripheral surface that is resiliently  
3 deformable to conform, in the vicinity of its engagement  
4 with the mold roll, generally to the peripheral surface of  
5 the mold roll.

1           48. The apparatus of claim 44 in which said means  
2 to maintain the mold gap comprises  
3           at least one actuator to elastically bend said  
4 nozzle to conform to radial deflections of the mold roll to  
5 maintain the mold gap, and  
6           a controller constructed to control said actuator to  
7 vary the amount of bending of the nozzle assembly.

1           49. An apparatus for continuously molding fastener  
2 elements integral with a base web, the apparatus comprising  
3           a cylindrical mold roll rotatable about an axis and  
4 comprising multiple stacked disks having fastener element-  
5 shaped mold cavities in their peripheral surfaces in a  
6 molding region,  
7           a cylindrical pressure roll arranged to engage said  
8 mold roll at a nip and to form a mold gap at said nip for  
9 forming said base web, the pressure roll constructed to  
10 apply operating pressure to force the resin into said  
11 cavities,  
12           an extrusion die to introduce a flowable resin to  
13 said nip, and  
14           means to maintain said mold gap at a desired  
15 thickness profile across said molding region under said  
16 operating pressure.

1           50. The apparatus of claim 49 wherein said molding  
2 region of the mold roll is of about 12 inches or more in  
3 length to produce a correspondingly wide web.

1           51. The apparatus of claim 49 in which said means  
2 to maintain the mold gap comprises  
3           a support roll arranged to engage the mold roll on  
4 the side generally opposite said pressure roll with  
5 sufficient force to resist radial deflection of said mold  
6 roll, and  
7           a controller constructed to control the amount of  
8 engagement between the support roll and the mold roll in  
9 response to operating conditions.

1           52. The apparatus of claim 49 in which said means  
2 to maintain the mold gap includes a controller to vary the  
3 angle between the axes of said pressure and mold rolls to  
4 introduce skew to compensate for mold roll radial deflection  
5 under said elevated operating pressure.

1           53. An apparatus for continuously molding fastener  
2 elements integral with a base web, the apparatus comprising  
3           a cylindrical mold hoop rotatable about an axis and  
4 having fastener element-shaped mold cavities in its  
5 peripheral surface,  
6           at least one driven roll arranged to engage an inner  
7 surface of said mold hoop to drive said hoop, and  
8           a pressure-applying means arranged to apply  
9 operating pressure to force the resin into said cavities at  
10 a pressure zone, said pressure-applying means and mold roll  
11 defining a mold gap therebetween for forming said base web.

1           54. The apparatus of claim 53 further comprising  
2 means to maintain said mold gap at a desired thickness  
3 profile across the width of said web under said operating  
4 pressure.

1           55. The apparatus of claim 53 further comprising  
2 means to extract heat from said inner surface of the mold  
3 hoop.

1           56. A method of continuously molding fastener  
2 elements on one broad side of a sheet product opposite  
3 another broad side having surface features, comprising  
4 providing an apparatus including  
5           a cylindrical mold roll rotatable about an axis  
6 and defining fastener element-shaped mold cavities at a  
7 peripheral surface thereof,  
8           a cylindrical pressure roll having a resilient,  
9 conformable surface arranged to engage said mold roll at a  
10 nip and to form a mold gap at said nip for forming said base  
11 web, the pressure roll constructed to apply operating  
12 pressure to force the resin into said cavities, and  
13           an extruder die to introduce molten resin to  
14 said nip,  
15           passing a sheet product having surface features  
16 through the nip with the molten resin such that the  
17 resilient surface of the pressure roll conforms in the  
18 vicinity of the surface features to protect the surface  
19 features of the product as they pass through the nip,  
20 thereby  
21           forming fastener elements integral with a base web  
22 on a broad side of the sheet product.

1           57. The method of claim 56 for forming an abrasive  
2 sheet product having molded fastener elements on one side  
3 and abrasive particles on the other side, in which the  
4 surface features comprise abrasive particles.

1           58. The method of claim 56 in which the surface  
2 features comprise a decorative texture.

1           59. The method of claim 56 in which the sheet  
2 product comprises a wall covering.